

Winter Maintenance Index

Presented by CROSS Zlin

1. Introduction

Winter Maintenance Index (WMI) is a **unique system of deep analysis and comparison of road winter maintenance performances and costs**. The users of this system are mainly administrators responsible for covering the maintenance costs but also contractors of winter road maintenance. WMI exactly describes winter conditions on a selected territory in a period of time and compare the real cost of road winter maintenance. In a situation that in many countries winter road maintenance has been privatized, the use of such analysis and control tool has become more important to make a qualitative interpretation of the costs. The company CROSS Zlin together with Czech Hydrometeorological Institute has been delivering WMI service for Czech state and regional authorities successfully since 2004 and now we are ready to offer the same service for foreign authorities.

1. Basic Principles

WMI is a system of analysis and comparison of road winter maintenance performances and costs depending on real meteorological conditions on a defined road and highway network.

The main activities that are monitored are:

- salting (or gritting) the roads and consumption of salt and other materials
- snow removal (ploughing)
- inspection routes

It is obvious that there is direct linkage between current weather conditions and extent of above mentioned parameters. It is also clear that when winter condition become more severe (snowfall, temperatures around zero, freezing rain, ice on the road etc) it is necessary to employ more maintenance vehicles and use larger amounts of salt that represent the major item in winter maintenance expenses.

WIM is a unique tool that enables retroactive control of road maintenance performances and comparison of maintenance level between different contractors. Based on this analysis it is possible to detect divergences from the standard level and separate any isolated or long-time anomalies and unjustified raising of costs.

2. Input data for the system

The basis for elaborating WMI is to establish **Winter Index** in defined region. For this task historical and current precise meteorological data are needed. To calculate Winter Index every parameter that influences the maintenance performance is taken into account, namely snowfall, temperatures, ice, frost etc. Winter Index is calculated individually for defined road network considering also the geographical conditions (e.g. altitude, vegetation coverage).

This data has to be collected from local official meteorological institutions that under normal conditions are the only organizations with sufficient number of professional weather stations and databases of historical weather data.

Second indispensable data input are winter maintenance performances from all the contractors in defined road network, namely these basic parameters:

- Gritting [km]
- Salting [km]
- Gritting and ploughing [km]
- Salting and ploughing [km]
- Ploughing [km]
- Inspection route with gritter [km]

- Inspection route with passenger car [km]
- Rotary ploughing [h]
- Salt consumption [t]
- Brine consumption [l]
- Sand consumption [t]

The above mentioned data inputs are collected directly from the maintenance contractors. In Czech Republic secured web forms are periodically filled out (see annex) but also other alternative methods are possible. Recommended frequency for data collection is one week (7 days) but according to local conditions other periods are acceptable.

3. Outputs

Winter maintenance performance in defined road network are periodically analyzed and compared to weather conditions. **Outputs are presented by detailed graphs with text description of the important discrepancies.**

Watched parameters are recalculated with respect to length of road network, geographical conditions (altitude) are also observed so it is possible to compare contractors working in different conditions.

Outputs are presented to a client in form of weekly and monthly analysis. **After the winter maintenance period a complex report is prepared describing in detail every watched parameter of every organization/contractor and presenting all anomalies and divergences from standard levels.**

Parallel output is **complete statistical overview** of winter maintenance data that can be accessible in real time on secured web page.

All outputs can be tailor-made respecting special wishes of the client.

4. Key benefits

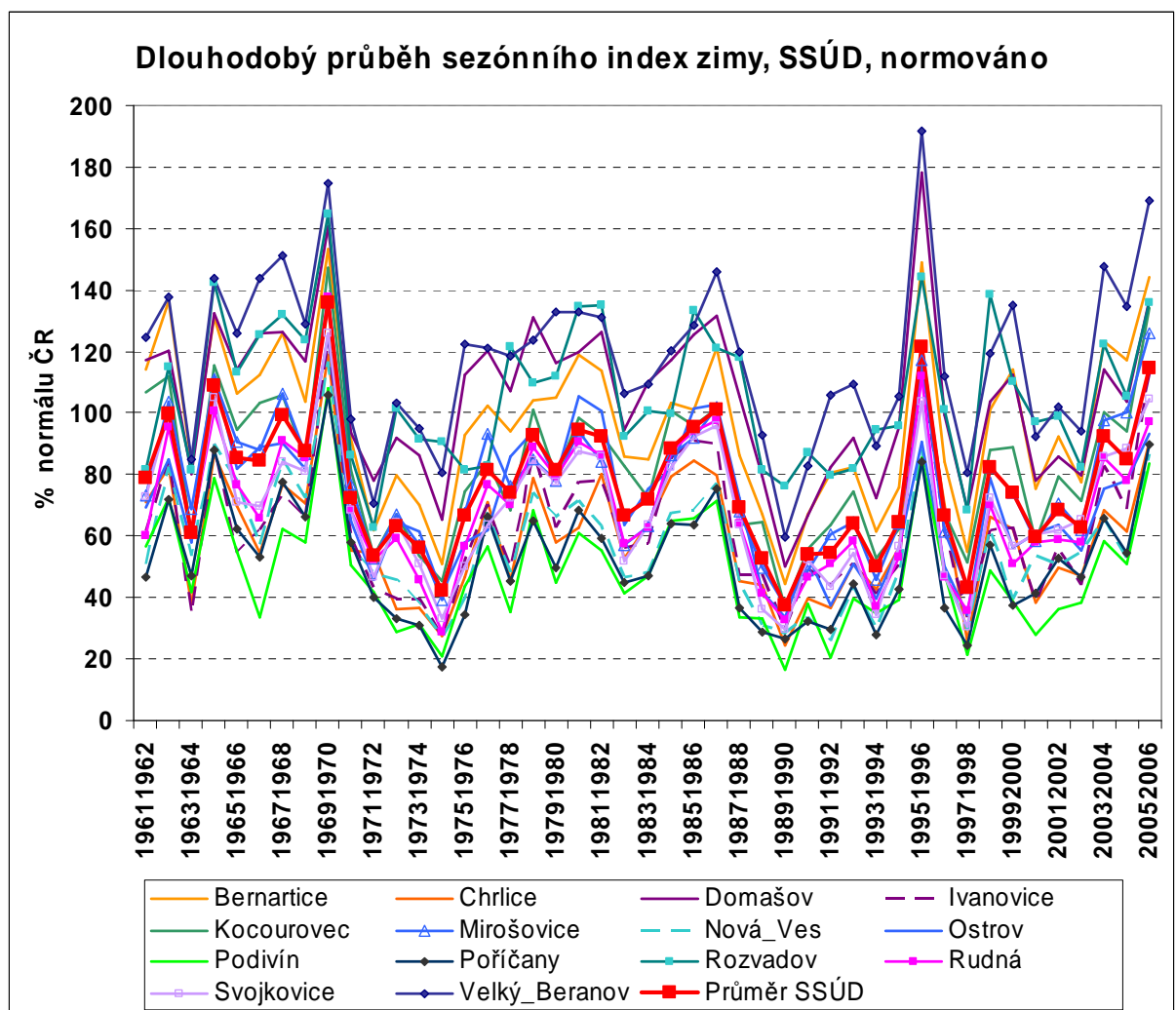
Winter Maintenance Index allows:

- Weekly, monthly and seasonal analysis of winter maintenance performances on road network depending on real meteorological conditions
- Evaluation of long-time meteorological conditions on selected territory from the winter maintenance demandingness perspective for planning purposes
- Detection of isolated anomalies and long-time divergences from standard maintenance levels
- Detection of administrative errors – e.g. numerical errors in input data from contractors
- Precise analysis of all winter period from the maintenance point of view
- Real time access to statistical data about consumption of salt and other spreading materials as well as other maintenance performances
- Objective evaluation of maintenance costs effectiveness in respect of weather conditions
- To achieve adequate quality of winter maintenance by using comparison methods of large number of contractors
- Effective collection of statistical data and easy real time access to statistical information

5. Conclusions

The purpose of Winter Maintenance Index here described is to give an objective indication of winter severity and especially to compare maintenance performances between different contractors or centers working in different climate conditions. Unlike systems used by some meteorological institutes in several European countries it is the first time that not only winter severity is calculated for specific regions but also a long-term average or standard of maintenance performances in that particular region is found and thus mentioned comparison between contractors or centers is made possible.

Winter Index example: long-term comparison of different highway maintenance centers in Czech Republic (years, % of Czech Republic average)



Winter Index percentages for Czech Republic highways

Note: average winter 100%

| Season [%] | HIGHWAY MAINTENANCE CENTERS | | | | | | | | | | | | | Total CZ |
|------------|-----------------------------|------------|------------|---------|------------|---------|--------|-------|-----------|--------|----------|----------|----------|----------|
| | Mrofovice | Bernartice | V. Beranov | Domašov | Kocourovce | Chřtice | Podlín | Rudná | Svojetice | Ostrov | Nová Ves | Poříčany | Rozvadov | |
| 19891970 | 177 | 142 | 132 | 137 | 161 | 190 | 184 | 190 | 187 | 136 | 192 | 208 | 121 | 160 |
| 19891990 | 54 | 63 | 59 | 48 | 50 | 48 | 38 | 53 | 52 | 65 | 59 | 50 | 68 | 56 |
| 19901991 | 66 | 84 | 75 | 63 | 73 | 46 | 89 | 67 | 67 | 91 | 72 | 62 | 95 | 74 |
| 19911992 | 100 | 105 | 100 | 80 | 88 | 64 | 52 | 86 | 86 | 91 | 72 | 67 | 115 | 89 |
| 19921993 | 86 | 95 | 98 | 92 | 112 | 80 | 84 | 97 | 99 | 90 | 85 | 88 | 94 | 93 |
| 19931994 | 61 | 73 | 86 | 73 | 69 | 58 | 64 | 54 | 57 | 82 | 55 | 57 | 107 | 72 |
| 19941995 | 78 | 83 | 90 | 89 | 68 | 85 | 86 | 76 | 81 | 101 | 80 | 72 | 105 | 85 |
| 19951996 | 139 | 143 | 146 | 168 | 125 | 137 | 182 | 151 | 157 | 120 | 128 | 134 | 110 | 140 |
| 19961997 | 76 | 90 | 94 | 106 | 70 | 101 | 124 | 77 | 71 | 81 | 84 | 74 | 97 | 88 |
| 19971998 | 62 | 65 | 74 | 70 | 55 | 48 | 61 | 57 | 56 | 65 | 57 | 48 | 80 | 63 |
| 19981999 | 113 | 119 | 110 | 105 | 117 | 131 | 118 | 118 | 121 | 138 | 140 | 128 | 152 | 124 |
| 19992000 | 88 | 120 | 117 | 113 | 137 | 111 | 83 | 80 | 81 | 107 | 76 | 85 | 128 | 106 |
| 20002001 | 79 | 80 | 76 | 71 | 72 | 64 | 53 | 84 | 80 | 82 | 96 | 77 | 86 | 78 |
| 20012002 | 90 | 101 | 90 | 80 | 113 | 112 | 76 | 92 | 87 | 101 | 92 | 102 | 100 | 95 |
| 20022003 | 61 | 63 | 65 | 75 | 74 | 74 | 81 | 63 | 63 | 75 | 72 | 64 | 74 | 69 |
| 20032004 | 122 | 137 | 121 | 105 | 131 | 121 | 116 | 127 | 121 | 111 | 109 | 121 | 114 | 120 |
| Average | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

Daily report of maintenance performances – example of web-based form

Operation center Responsible person

ROAD WINTER MAINTENANCE RECORD

From [DD.MM.YYYY] [HH:MM] To [DD.MM.YYYY] [HH:MM]
 Day Hour Day Hour

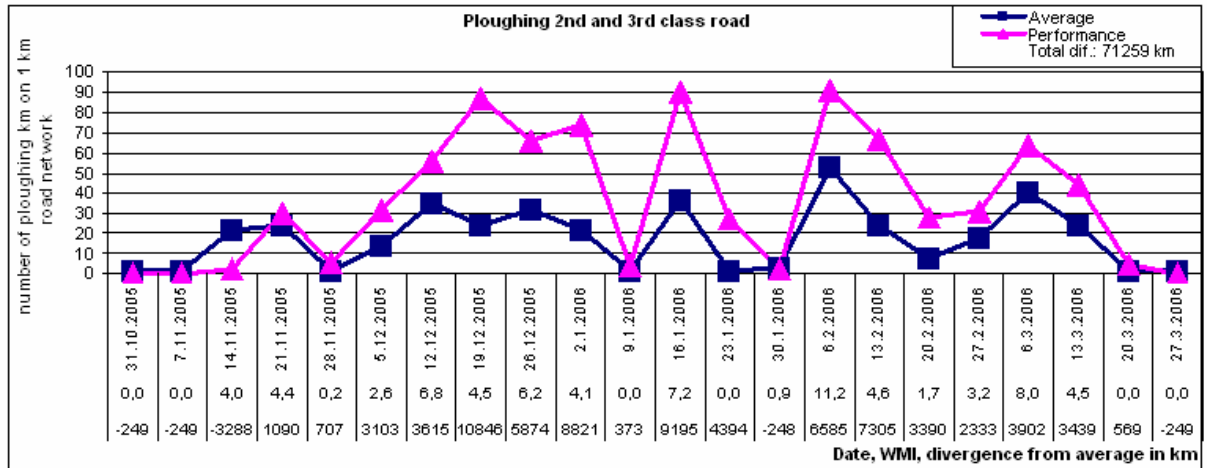
| Winter maintenance performances | Highways, I. class roads | II. and III. class roads | |
|-------------------------------------|--------------------------|--------------------------|------|
| Gritting | <input type="text"/> | <input type="text"/> | [km] |
| Salting | <input type="text"/> | <input type="text"/> | [km] |
| Gritting and ploughing | <input type="text"/> | <input type="text"/> | [km] |
| Salting and Ploughing | <input type="text"/> | <input type="text"/> | [km] |
| Ploughing | <input type="text"/> | <input type="text"/> | [km] |
| Inspection route with gritter | <input type="text"/> | <input type="text"/> | [km] |
| Inspection route with passenger car | <input type="text"/> | <input type="text"/> | [km] |
| Rotary ploughing | <input type="text"/> | <input type="text"/> | [h] |
| Salt consumption | <input type="text"/> | <input type="text"/> | [t] |
| Brine consumption | <input type="text"/> | <input type="text"/> | [t] |
| Sand consumption | <input type="text"/> | <input type="text"/> | [t] |

Filled by

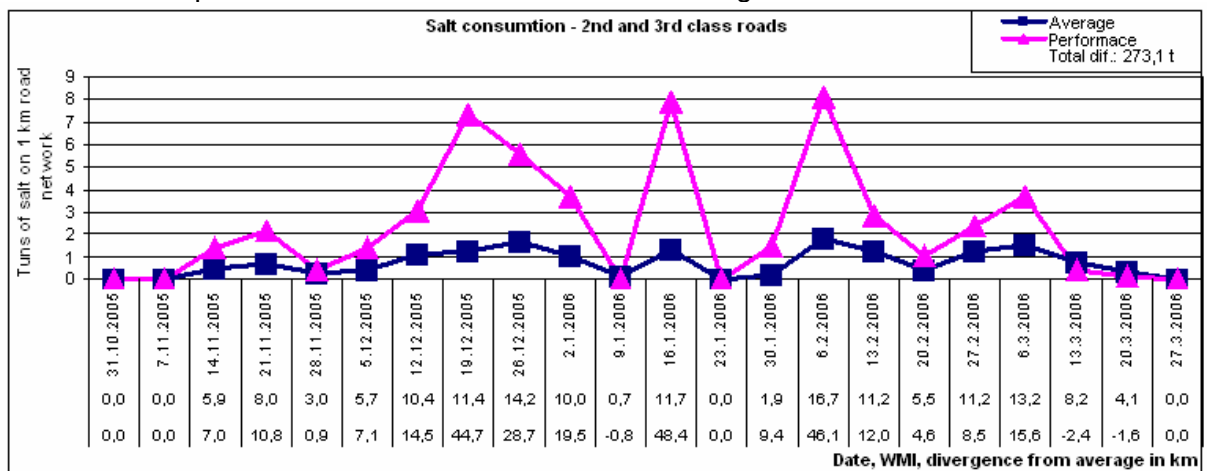
Real outputs – examples

Notes: blue graph = regional (Czech Republic) average performance weekly
 Violet graph = performance of particular contractor weekly

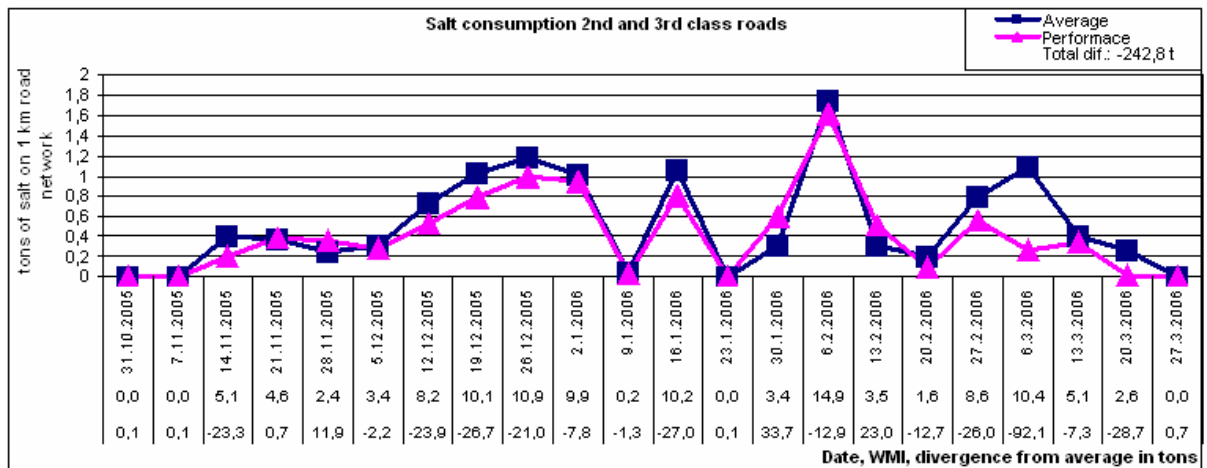
1. Ploughing - considerable difference from average



2. Salt consumption - considerable difference from average



3. Salt consumption – example of average performance without noticeable differences



4. Contractors comparisons, total for winter period

| Contractor | Divergence from average performance (%) | | |
|---------------|---|---------|--------|
| | Ploughing | Salting | Salt |
| Contractor 1 | 36,9 | 12,1 | -19,7 |
| Contractor 2 | 9,7 | 2,0 | 4,0 |
| Contractor 3 | -24,3 | -9,4 | 59,1 |
| Contractor 4 | -32,9 | -7,4 | 27,3 |
| Contractor 5 | 24,3 | 20,0 | -56,9 |
| Contractor 6 | 124,6 | 16,3 | -4,8 |
| Contractor 7 | -84,4 | -62,5 | -39,6 |
| Contractor 8 | -28,4 | -27,6 | -16,4 |
| Contractor 9 | 25,0 | 24,9 | -100,0 |
| Contractor 10 | -31,0 | -1,7 | 14,7 |
| Contractor 11 | -83,7 | -68,3 | -16,8 |
| Contractor 12 | 2,6 | 94,8 | -53,0 |
| Contractor 13 | -58,7 | -51,0 | -29,9 |
| Contractor 14 | 61,8 | -19,2 | 41,4 |
| Contractor 15 | -72,7 | -58,1 | -57,0 |
| Contractor 16 | 71,8 | 17,7 | 233,3 |
| Contractor 17 | 163,3 | 9,2 | -18,8 |

| Color scheme: | |
|---------------|-----------------|
| | less than -25 % |
| | -15 to -25 % |
| | -15 to 15 % |
| | 15 to 25 % |
| | more than 25 % |